## Development of multi-mesh Cellular Automata-Finite Element model of dynamic recrystallization during rolling process

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## ABSTRACT

Development of uncoupled upscaling multi scale cellular automata finite element (CAFE) model of dynamic recrystallization (DRX) dedicated to hot rolling process is the main goal of the present paper. Besides recovery, the DRX is the most important process responsible for microstructure restoration during large plastic deformation and have to be properly predicted during numerical simulations [1]. The digital material representation concept [2], where microstructure is explicitly taken into account during simulation, was used within the work. Evolution of microstructure was simulated on the basis of discrete cellular automata (CA) method, that provides capability to predict in detail changes in microstructure morphology during recrystallization. Major assumptions of the developed CA DRX model can be found in previous authors work [3], while current paper is focused on incorporation of the multi-mesh concept into the CA model to increase its predictive capabilities.

The multi-mesh concept was applied to the dislocation density  $\rho$  distribution model that is crucial to evaluate the driving force for grain growth during recrystallization. Dislocation density  $\rho_{i,j}$  was calculated independently for each CA cell in the model, based on actual recrystallization volume fraction in the particular time step and on the information obtained from the macro scale finite element method or from the solution of the internal variable model. To increase model accuracy each CA cell has its own dislocation sub-mesh as seen in Fig. 1, which is used to precisely evaluate dislocation density. The coarse CA mesh is used to model grain growth based on the information supplied from the fine mesh. That way developed model is insensitive to the CA cell size changes, and provides comparable results for different physical dimension of the model.



Fig 1. General concept of the multi – mesh approach.

Finally developed CA DRX micro scale model was connected with the macro scale finite element approach to simulate microstructure evolution during the hot rolling process.

## REFERENCES

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